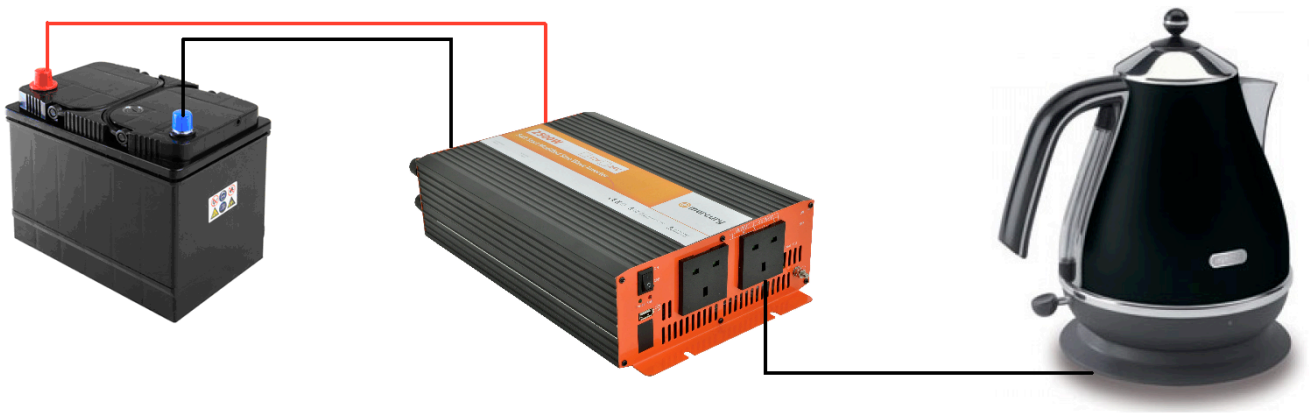
Guide to Power Inverters

What does a power inverter do, and what can I use one for?

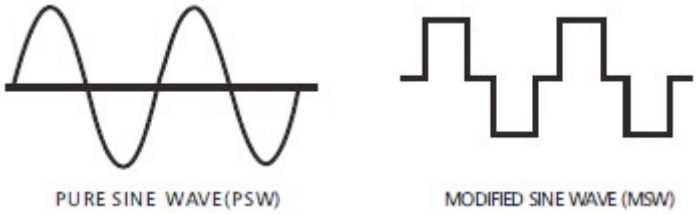
A power inverter changes direct current (DC) power from a battery, usually 12V or 24V, into conventional mains alternating current (AC) power at 230V. This means that you can use one to operate all kinds of devices ... electric lights, kitchen appliances, power tools, TVs, radios, computers, to name just a few.

Just connect the inverter to a battery, and plug your AC devices into the inverter and you've got portable power whenever and wherever you need it.



The inverter draws its power from a 12V or 24V battery (preferably deep-cycle), or several batteries wired in parallel. The battery will need to be recharged as the power is drawn out of it by the inverter. The battery can be recharged by running the car or lorry motor, or a generator, solar panels, or wind turbine. Or you can use a battery charger plugged into an AC outlet to recharge the battery.

Types of Inverter



There are 2 types of inverters available for use in consumer applications. These are:

Pure Sine Wave Inverters:

The name pure sine wave inverters come from the wave form of its output. They have pure sine wave form output as show in above diagram. This is identical or to replicate as close as possible to general mains. As most electronic products are designed to be powered by mains, pure sine wave inverters are suitable for all applications, especially motorised devices where it is proven that pure sine wave power will lengthen the product's lifetime and run much quieter.

Pure sine wave inverters are more expensive than modified sine wave inverters because they involve a much more sophisticated design in order to simulate the smooth output of standard mains power.

Modified Sine Wave Inverters

Again modified sine wave inverters are named after their output waveform. The output of the modified sine wave inverter cycles through positive, ground and negative voltage as shown in the diagram above, to give a similar output waveform to pure sine wave.

Modified sine wave inverters are a much cheaper alternative to pure sine wave inverters as they don't require the complicated system needed to smooth and render the output waveform. The only down side with a modified sine wave is that it introduces harmonic distortion to inductive and audio equipment. This is caused by the harsh clipping in the on and off phase changing in voltage. However, modified sine wave inverters are suitable for heat element devices (kettle, heater, etc) and devices that have an external or built-in adaptor (laptop, TV, etc).

How do I choose between Modified Sine Wave or Pure Sine Wave Inverters?

Advantages of pure sine wave inverters over modified sine wave inverters:

a) Output voltage wave form is pure sine wave with very low harmonic distortion and clean power like utility-supplied electricity.

b) Inductive loads like microwave ovens and AC motors run faster, quieter, cooler and more efficient.

c) Reduces audible and electrical noise in fans, fluorescent lights, audio amplifiers, TV, games consoles, fax machines, and answering machines.

d) Prevents crashes in computers, glitches and noise in monitors.

e) Reliably powers the following devices that normally won't work with modified sine wave inverters:

- Laser printers, photocopiers, magneto-optical hard drives.
- Some fluorescent lights with electric ballasts.
- Power tools running on AC motor and variable speed control.
- Sewing machines with speed/microprocessor control.
- Charger for rechargeable battery.

Modified sine wave works well for most devices, and is the most common type of inverter on the market, as well as the most economical.

If you mostly want to run lights (none ballast), TV, kettle, heater, etc, a modified sine wave inverter is suitable for your needs.

Pure sine wave inverters (also known as true sine wave) are more suited for sensitive electrical devices such as laser printers, inductive devices (ballast, compressor, AC motor), variable speed control devices and audio equipment.

Using an Inverter for Emergency Home Backup Power

A very simple way to use an inverter for emergency power (such as during a power outage), is to use a car battery (with the vehicle running), and an extension cord running into the house, where you can then plug in electrical appliances.

What output power inverter should I buy?

The output power you require depends on the power (Watts) of devices that you want to run. The power information of most devices can usually can be found on a specification label on the product or packaging, if you have any uncertainty please contact the retailer or customer service department of the manufacturer. We recommend you choose an inverter with 20 to 50% extra of total power required and with minimum of twice the power of the largest device you will be using.

The reason for requiring twice the largest power device is that the power rating on any device is based on continuous power. When an electronic device is starting up, there is a surge of current. This power surge is normally two times, but can be up to seven times (such as ac motors), of the rated continuous power. Therefore choosing an inverter with a higher power output will reduce the risk or damaging your electrical items, power supply or the inverter itself.

Example:

You want to power a computer, some lights and a radio with power as below.

Computer:	300W
2 x 60W lights:	120W
Radio:	10W
Total Power Needed:	**430W**

For this application, an inverter with minimum power of 600W is recommended.
As 600W is twice the power of the highest power device and the total power of 430W is still within the maximum power rating of the inverter. Of course it will be more ideal to move one step up and choose a 1000W inverter which would allow for additional devices to be powered or added on in the future.

Helpful formulae:

Many specifications on the product only quote current (amps) instead of power, to convert current to power, below formula can be used:

To convert Amps to Watts:

Current (Amps) × 230 (AC voltage) = Power (Watts)

This formula yields a close approximation of the continuous load of the appliance.

To calculate approximate start-up load:

Power (Watts) × 2 = Start-up Load

This formula yields a close approximation of the starting load required by the appliance, although some appliances may require an even greater starting load.

Note: Induction motors such as air conditioners, refrigerators, freezers and pumps may have a start-up surge of up to seven times their continuous power rating.

Most often the start-up load of the appliance or power tool determines whether an inverter has the capability to power it.

For example, you have a freezer with a continuous load of 2 Amps, and a start-up load of 6 Amps:

2 Amps x 240 Volts = 480 Watts continuous
6 Amps x 240 Volts = 1440 Watts starting load

You would need an inverter with peak-surge rating greater than 1440W.

To work out current/battery capacity requirement (for 12V system):

Power (Watts) / 12V = Current hour (Ah)

This is the rough calculation for the size of a vehicle alternator you would need to keep up with a specific load, as an inverters efficiency is only rated around 90%, the current requirement will need to be 10% higher; for example, to keep up with a continuous draw of 1000W, you would need:

$(1000 \div 12) \times 1.1 = 91.67Ah$

Therefore an alternator with minimum output current of 91.67A at 12V is required to run continuously. Alternatively a fully charged 12V battery with capacity of 91.67Ah can run continuously for around an hour.

How do I connect the Inverter? What size cable should I use, and is it included?

Many small inverters (300W and under) come with crocodile clips which are attached to the positive and negative terminals of the battery.

Larger inverters (500W and over) must be hard-wired directly to a battery. The cable size depends on the distance between battery and inverter, and will be specified in the instruction manual for the inverter.

When connecting the inverter to the battery use the thickest wire available, in the shortest length practical.

General recommendations: (cable sizes are expressed as AWG)

Inverter Power Output	< 1m	1m – 2m	2m – 3m
600W	6	4	2
1000W	4	2	1/0
1500W	2	1	3/0
2500W	1/0	3/0	350

NOTE: These are general recommendations for inverters that utilise a single cable set (one positive and one negative cable) only and may not be correct for all inverters or applications. Additionally, some inverters require two or more cable sets and therefore may require a different cable size than listed.

Cable size recommendations may vary among inverter brands and models; please check the Instruction manual for the model you have purchased before you buy the wire for it.

The maximum length generally recommended is 3m, and shorter runs are recommended to reduce resistance and heating effect of the cable and improve the efficiency. If longer distance is required from battery to the device, it is recommended to extend from the AC output rather than on the DC input side.

What type of battery should I use (automotive or deep cycle)?

Small Inverters (up to 500W)

Most leisure and marine batteries will provide an ample power supply for 30 to 60 minutes even when the engine is off. Actual time may vary depending on the age and condition of the battery, and the power demand being placed on it by the equipment being operated by the inverter. If you use the inverter while the engine is off, you should start the engine every hour and let it run for 10 minutes to recharge the battery.

Larger Inverters (500W and above)

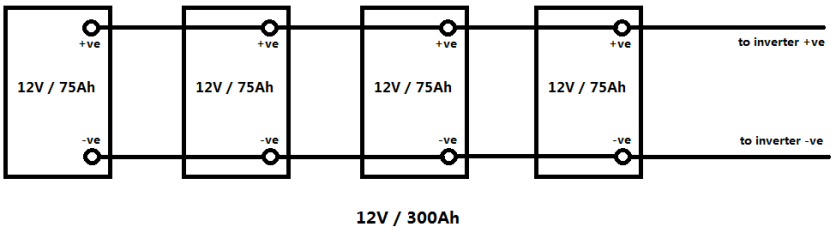
We recommend you use deep cycle batteries which will give you several hundred complete charge/discharge cycles. If you use the normal vehicle starting batteries they will wear out after about a dozen charge/discharge cycles. If you do not have a deep cycle battery, we recommend that you keep the engine of your vehicle running whilst using the power inverter.

When using the inverter with a deep cycle battery, start the engine every 30 to 60 minutes and let it run for 10 minutes to recharge the battery.

When powering appliances with high continuous load ratings for extensive periods, it is not advisable to power the inverter with normal car battery. If the car battery is used for an extended period, it is possible that the battery charge may be drained to the point where the battery has insufficient power to start the vehicle. In these cases, it's a good idea to have an extra deep cycle battery installed for the inverter (installed close to the inverter), cabled to the original battery/alternator. It is also recommended that a suitable battery isolator should be installed between the two batteries.

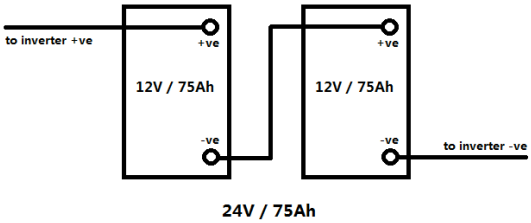
How do I connect two or more batteries?

It may be advisable to operate the inverter from an array of 12V batteries of the same type in a "parallel" configuration. Two such batteries will generate twice the Amps/hour of a single battery; three batteries will generate three times the Amps/hour, and so on. This will lengthen the time before your batteries will need to be recharged, giving you a longer time that you can run your appliances.

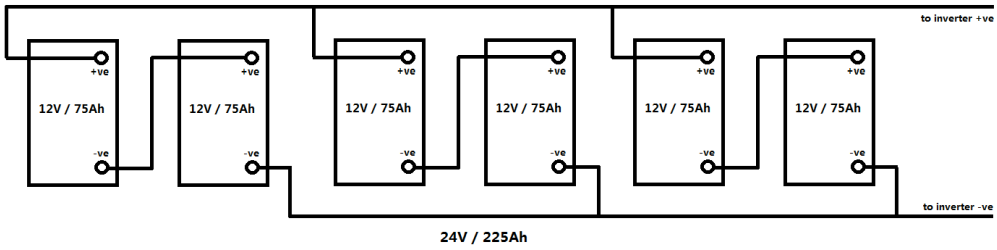


For 24V inverters, below array connection of 12V batteries can be used to increase the total capacity:

24V OUTPUT – SERIES CONNECTION (voltage increase current remain)



24V OUTPUT – SERIES/PARALLEL CONNECTION (both voltage and current increase)



Operating a computer with a Modified Sine Wave Inverter?

With the exception of some laptops most computers will work fine, although some CRT monitors will experience some interference such as lines or a hum.

However, if you have any doubt about any appliance, tool or device, particularly laptop computers, we recommend that you check with the manufacturer to be sure it is compatible with a modified sine wave inverter. If it is not, choose one of our pure sine wave inverters instead.

The difference between them is the pure sine wave inverter produces a better and cleaner current. However, they are also considerably more expensive due to the electronics inside.

Microwave Ovens & Power Inverters

The power rating used with microwave ovens is the "cooking power" which refers to the power being "delivered" to the food being cooked. The actual operating power requirement rating is higher than the cooking power rating (for example, a microwave with "advertised" rating of 600W usually corresponds to almost 1200W - 1500W of power consumption). The actual power consumption is usually stated on a label located at the back of the microwave. If the operating power requirement cannot be found on the back of the microwave, check the instruction manual or contact the manufacturer.

None LED Camera Flashes & Power Inverters

A none LED camera flash generally requires a pure sine wave inverter capable of surging to at least four times the Watt Sec rating of the strobe. For instance, a camera flash rated at 300W requires an inverter capable of 1200W or more.

Laser Printers & Power Inverters

A laser printer generally requires a pure sine wave inverter capable of producing at least three times the continuous wattage rating of the printer. For instance, a laser printer rated at 500W requires an inverter rated at 1500W or higher.

An inkjet printer does not maintain the same requirements as a laser printer. Inkjet printers can be operated normally with a modified sine wave inverter rated to handle the printer's wattage requirements.

Television & Audio Suggestions

Although most inverters are shielded and filtered to minimise signal interference, some interference with your television picture may be unavoidable, especially with weak signals.

Here are some suggestions that may improve reception:

1. First make sure that the television antenna produces a clear signal under normal operating conditions (i.e., at home plugged into a standard mains wall outlet). Also ensure that the antenna cable is properly shielded and of good quality.

2. Change positions of the inverter, antenna cables and television power cord.

3. Isolate the television, its power cord and antenna cables from the 12V power source by running an extension cord from the inverter to the TV set. Ensure that any excess AC power cord is a distance away from the TV set.

4. Coil the television power cord and the input cables running from the 12V power source to the inverter.

5. Attach a "Ferrite Data Line Filter" to the television power cord. More than one filter may be required.

NOTE: Some inexpensive audio systems may experience a slight "buzzing" sound when operated with a modified sine wave inverter. This is caused by deficient filters in the audio system. Pure sine wave inverter can be used to reduce the buzzing noise.

Appliance Cautions:

DO NOT use an inverter to directly recharge nickel-cadmium batteries through appliances. Always use the charger provided with that appliance.

DO NOT plug in battery chargers for cordless power tools if the charger carries a warning that dangerous voltages are present at the battery terminals.

Some fluorescent lamps may not be fully compatible with an inverter. If the lamp appears to be too bright, flickering or fails to light up, do not use the lamp with an inverter.

Some fans with synchronous motors may slightly increase in speed (RPM) and increase in noise when powered by an inverter.

Certain chargers for small nickel-cadmium batteries can be damaged if plugged into a modified sine wave inverter. In particular, two types of appliances are susceptible to modified sine wave:

- Small, battery-operated appliances such as flashlights, cordless razors and toothbrushes that can be plugged directly into an AC receptacle to recharge.

- Certain battery chargers for battery packs that are used in some cordless hand-tools. Chargers for these tools have a warning label stating that dangerous voltages are present at the battery terminals.

DO NOT use modified sine wave inverters with the above two types of equipment.

The majority of portable appliances do not have this problem. Most portable appliances use separate transformers or chargers that plug into AC receptacles to supply a low-voltage DC or AC output to the appliance. If the appliance label states that the charger or adaptor produces a low-voltage DC or AC output (30V or less), there should be no problem powering that charger or adaptor.

Safety Warning: 240V of electricity can be lethal. Improper use of a power inverter will result in property damage, personal injury, or loss of life. Please read and follow carefully the instructions in the instruction manual provided with every inverter for important safety considerations and precautions.

General Safety Precautions and Installation Tips:

- Place the inverter on a reasonably flat surface, either horizontally or vertically.
- The inverter should not be installed in the engine compartment, due to possible water/oil/acid contamination, and excessive heat under the bonnet, as well as potential danger from petrol fumes and the spark that an inverter can occasionally produce. It's best to run battery cables to a dry, cool mounting location.
- Keep the inverter dry. Do not expose it to rain or moisture. **DO NOT** operate the inverter if you, the inverter, the device being operated, or any other surfaces that may come in contact with any power source are wet. Water and many other liquids can conduct electricity which may lead to serious injury or death.
- Avoid placing the inverter on or near heating vents, radiators or other sources of heat. Do not place the inverter in direct sunlight. Ideal operating temperature is between 10° and 30°C.
- In order to properly disperse heat generated while the inverter is in operation, keep it well ventilated. While in use, maintain several inches of clearance around the top and sides of the inverter.
- **DO NOT** use the inverter near flammable materials.
- **DO NOT** install inverters in unvented battery compartments.

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